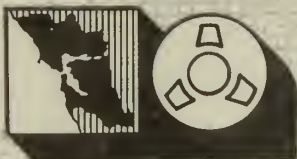




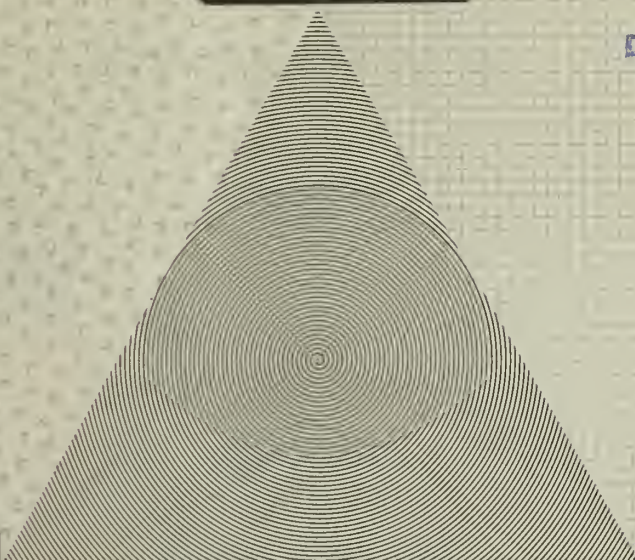
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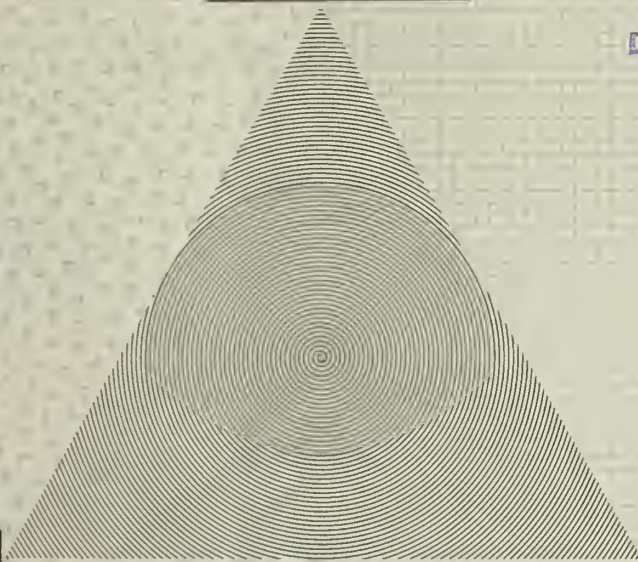
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A GUIDE TO

ABAG'S

EARTHQUAKE HAZARD MAPPING

CAPABILITY

MARCH 1980

REVISED MARCH 1981

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We would like to thank those many people at USGS and working for cities and counties in the Bay Area who took the time to review the many papers that form the basis for this guide.

TABLE OF CONTENTS

Introduction	White
Basic Data Map Files	Yellow
Hazard Map Files	Goldenrod
Map File Applications	Green
Working Papers (Not automatically included)	White
	graphics:
	Pat Yoshitsu
	Merrilee Ollendick

REVISIONS TO BASIC DATA MAP FILES (through March 1981)

GEOLOGY

Coverage has been increased for fifteen 7-1/2 minute quadrangles in the Petaluma and East Bay ridglands areas, including the Cotati, Glen Ellen, Petaluma, Petaluma River, Briones Valley, Las Trampas Ridge, Diablo, Hayward, Dublin, Niles, Milpitas, Calaveras Reservoir, San Jose East, Morgan Hill, and Mt. Sizer quadrangles. The four bedrock categories are broken into 65 categories in the Ridglands area and into 35 categories in the Petaluma area.

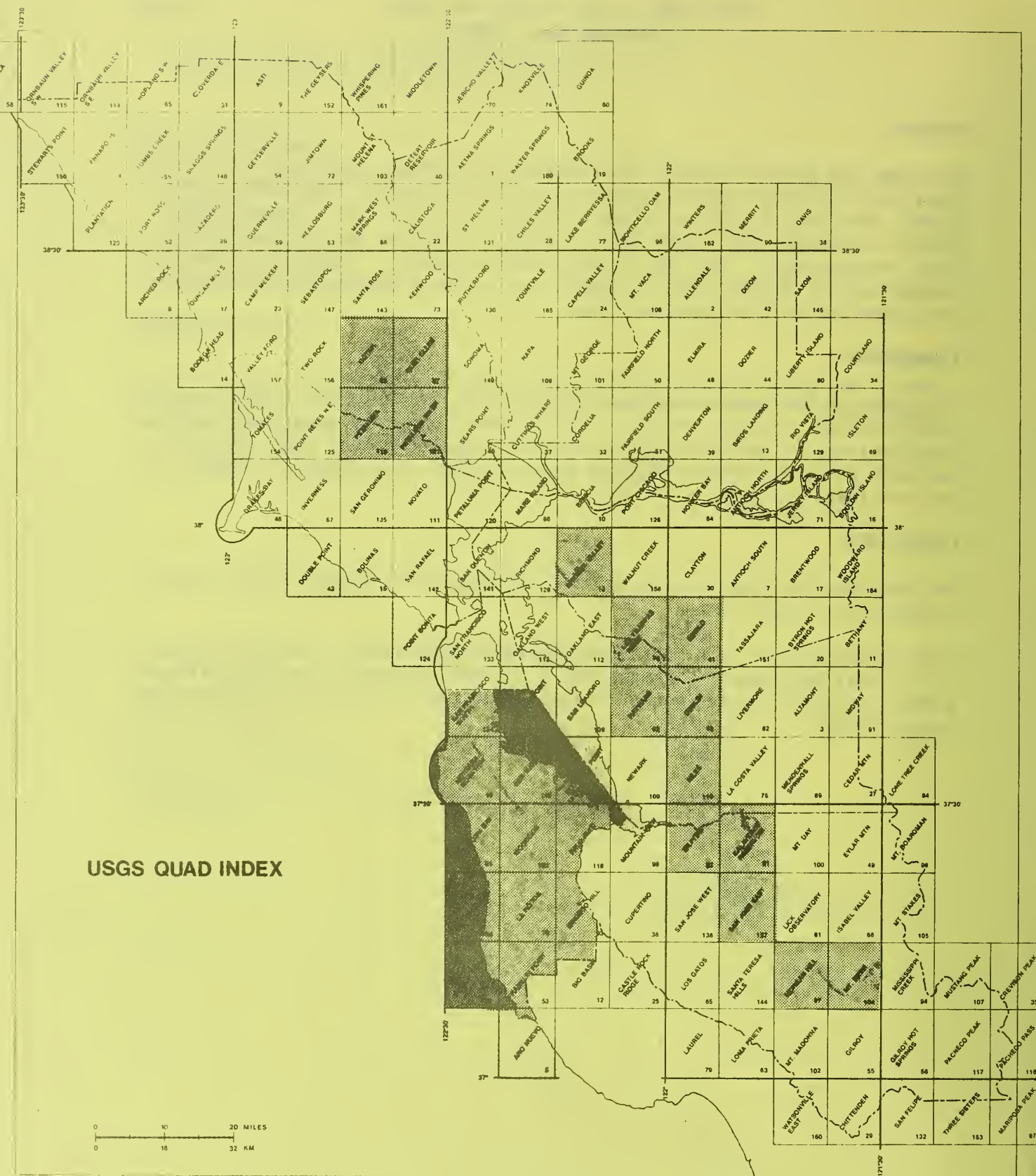
TOPOGRAPHY

The coverage has been increased to include the fifteen 7-1/2 minute quadrangles listed above. The scale has been improved since calculations are performed using 30 meter squares rather than hectares. Hectare files of slope and slope aspect (eight directions of slope) are now available.

LANDSLIDES

The coverage has been increased to include the fifteen 7-1/2 minute quadrangles listed above.

More information on all of these files is contained in Working Paper #11. Coverage should increase for all three of these files for fifteen additional quadrangles in the central urban portion of the Bay Area by January 1982.



REVISIONS TO HAZARD MAP FILES (through March 1981)

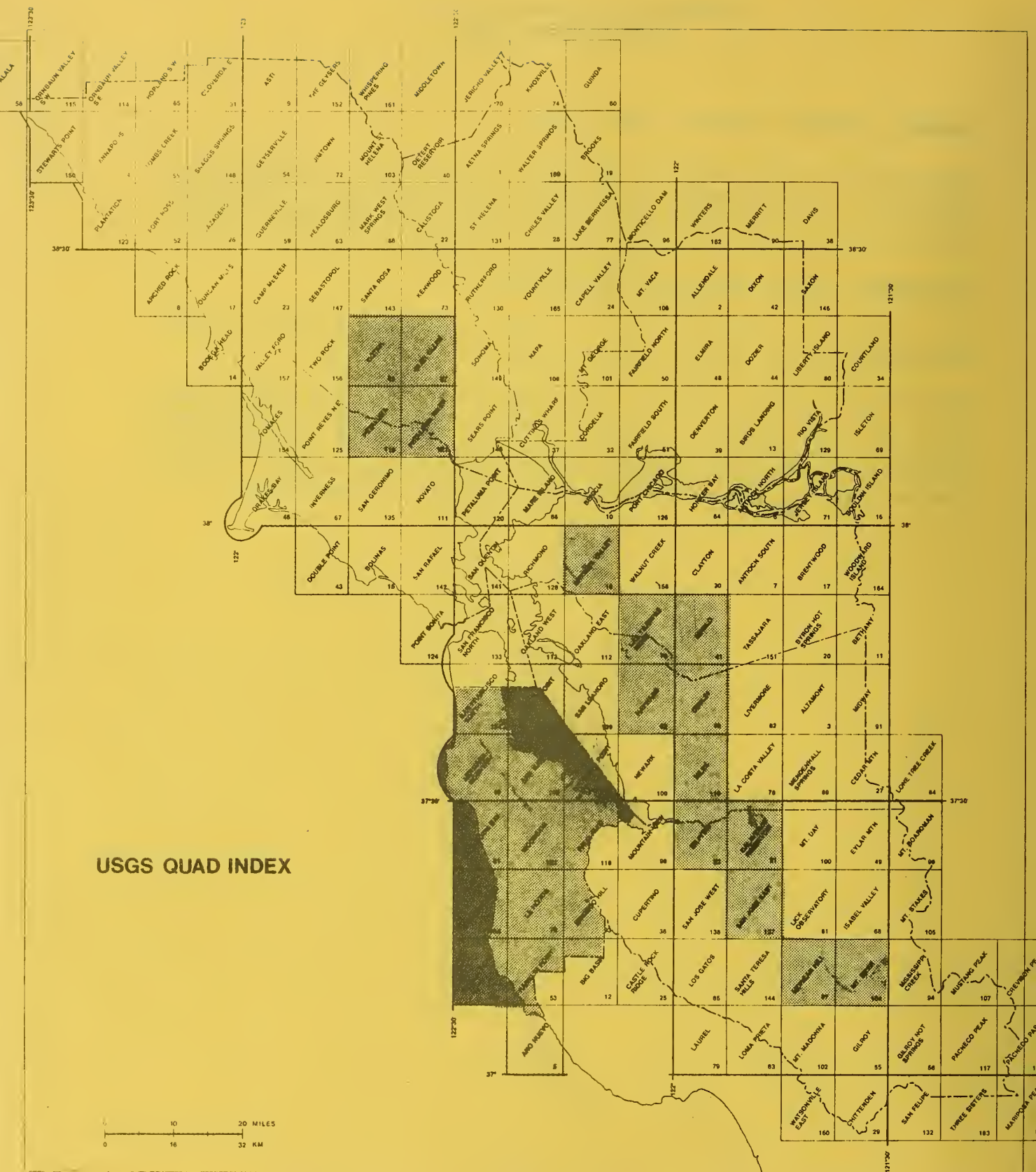
RAINFALL-INDUCED LANDSLIDE SUSCEPTIBILITY

The coverage of this map file has been increased to include fifteen quadrangles in the Petaluma and East Bay ridgelands areas. In addition, the factors contributing to the susceptibility model have been increased to include slope aspect, average annual precipitation, and vegetation.

EARTHQUAKE-INDUCED LANDSLIDE SUSCEPTIBILITY

The coverage of this map file has been increased to include fifteen quadrangles in the Petaluma and East Bay ridgelands areas.

More information on both of these files is contained in Working Paper #11. Coverage should increase for both of these files for fifteen additional quadrangles in the central urban portion of the Bay Area by January 1982. The maximum ground shaking intensity and risk of ground shaking intensity maps are scheduled for revision in June 1981.



MAP FILE APPLICATIONS (revised March 1981)

As of March 1981, these map files can be manipulated for four different types of applications:

- o local general plans
- o computer assisted environmental assessment
- o production of composite hazard maps and site screening
- o assessment of current projected property and population at risk

Each of the following sheets consists of five major sections describing various aspects of the applications on the front and a sample of an application product on the back. The five sections include:

- o Coverage - the area of the region covered (including a map) and the resolution of the data
- o Source files - a list of the basic data map files and the hazard map files used
- o Description of product
- o Further information on this file is contained in - a list of the working papers further describing the map application
- o Limitations and future plans - limitations in coverage or accuracy are described, together with future plans to improve ABAG's ability to produce the products described



LOCAL GENERAL PLANS

MAP FILE APPLICATION

COVERAGE: All nine Bay Area counties with San Mateo County, Petaluma, and the East Bay ridgelands in more detail

SOURCE FILES: Geology; Faults; Topography; Landslides; Tsunami Inundation Areas; Dam Failure Inundation Areas; Maximum Ground Shaking Intensity; Risk of Ground Shaking Damage; Liquefaction Susceptibility; Liquefaction Potential; Rainfall and Earthquake-Induced Landslide Susceptibility; Fault Surface Rupture



March 1981
Hectare resolution

DESCRIPTION OF PRODUCT:

One of the appropriate ways to use the mapped information is for identifying hazardous areas in a safety or seismic safety element of a local general plan. The latest State General Plan Guidelines for these elements recommend having several maps, most of which are available through ABAG's earthquake hazard mapping work. The table on the back of this page lists those maps available through ABAG that are recommended in the State Office of Planning and Research Guidelines. The cost of these maps depends on the quantity ordered and the map scale specified.

FURTHER INFORMATION ON THIS FILE IS CONTAINED IN:

o Working Paper #12: Ordering and Using Earthquake Hazard Maps in Local General Plans

LIMITATIONS AND FUTURE PLANS:

Most maps are available for the entire region. However, the slope, slope aspect, landslide, landslide susceptibility and composite maps are only available for San Mateo County, the Petaluma area and the East Bay ridgelands at this time.

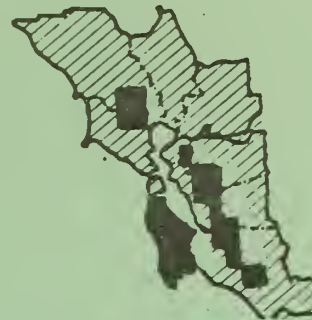


COMPUTER ASSISTED ENVIRONMENTAL ASSESSMENT

MAP FILE APPLICATION

COVERAGE: All nine Bay Area counties with San Mateo County, Petaluma, and the East Bay Ridgeland in more detail

SOURCE FILES: Geology; Faults; Topography; Landslides; Tsunami Inundation Areas; Dam Failure Inundation Areas; Maximum Ground Shaking Intensity; Risk of Ground Shaking Damage; Liquefaction Susceptibility; Liquefaction Potential; Rainfall and Earthquake-Induced Landslide Susceptibility; Fault Surface Rupture



March 1981
Hectare resolution

DESCRIPTION OF PRODUCT:

This application will produce a background document for development proposals that can be incorporated into the Environmental Impact Report (EIR). This document currently has eleven parts, each focusing on a different social or environmental concern. The part dealing with earthquake hazards in "Geology and Soils--Hazards and Resources". Each section, including the one on geology and soils, contains three parts--setting, impacts, and mitigation. The setting section contains information on five data items: topography, faults, landslides, geologic materials, and soil associations. The impacts section contains information on: rainfall-induced landslide susceptibility, earthquake-induced landslide susceptibility, liquefaction potential, tsunami inundation areas, dam failure inundation areas, maximum earthquake intensities, and earthquake intensity damage and risk. The mitigation section would include those items to be required of the developer by the city or county, including requirements for further study. An extensive list of possibilities is contained in Working Paper #13. The information for each section is presented on single page. A copy of the impacts section for a hypothetical development is reproduced on the back of this sheet.

FURTHER INFORMATION ON THIS FILE IS CONTAINED IN:

- o Working Paper #8 : Earthquake Map Applications for Automated Environmental Impact Assessment
- o Working Paper #13: Automated Environmental Impact Assessment
An Update

LIMITATIONS AND FUTURE PLANS:

At the present time, because of the limited coverage of the topography, landslide, and landslide susceptibility files, a complete report can be produced only for San Mateo County, Petaluma and its vicinity, and the East Bay ridgeland. The coverage will be expanded to include fifteen urban 7-1/2 minute quadrangles of high development potential in 1981 and early 1982. The file also could be expanded should a city or county request the service and provide funds for file development.

 * SWEENEY RIDGE: AUTOMATED ENVIRONMENTAL IMPACT ASSESSMENT *

GEOLOGY AND SOILS - HAZARDS AND RESOURCES

 IMPACTS

MAXIMUM EARTHQUAKE INTENSITY

	AREA(HECTARES)
A (4)-VERY VIOLENT	0.
B (3)-VIOLENT	36.
C (2)-VERY STRONG	63.
D (1)-STRONG	242.
E (0)-WEAK	101.
NEGLECTIBLE	0.

RISK OF DAMAGE

EXPECTED RISK OF GROUND-SHAKING DAMAGE
 FOR BUILDING TYPES PROPOSED FOR SITE
 (ESTIMATE BASED ON STATISTICAL PROCEDURES
 USING MAJOR FAULT EARTHQUAKE RECURRENCE
 INTERVALS AND AVERAGE BUILDING DAMAGE)

PRESENT VALUE OF PERCENT DAMAGE		WOOD FRAME DWELLINGS	CONCRETE/STEEL BUILDINGS	TILT-UP CONCRETE
0.0-1.0% MODERATE		442.	406.	343.
1.1-2.0%	*	0.	34.	63.
2.1-3.0%	*	0.	2.	21.
3.1-4.0% HIGH		0.	0.	13.
4.1-5.0%	*	0.	0.	2.
5.1-6.0%	*	0.	0.	0.
>6.0% VERY HIGH		0.	0.	0.

LIQUEFACTION POTENTIAL

	AREA(HECTARES)
VERY LOW	442.
*	0.
*	0.
LOW	0.
*	0.
*	0.
MODERATE	0.

SLOPE STABILITY

RAINFALL-INDUCED
 LANDSLIDE SUSCEPTIBILITY

	AREA(HECTARES)
STABLE	112.
*	316.
*	0.
*	0.
*	0.
*	0.
UNSTABLE	14.

EARTHQUAKE-INDUCED
 LANDSLIDE SUSCEPTIBILITY

	AREA(HECTARES)
STABLE	294.
*	96.
*	21.
UNSTABLE	31.

TSUNAMI INUNDATION AREAS

	AREA(HECTARES)
INSIDE	0.
OUTSIDE	442.

DAM FAILURE INUNDATION AREAS

	AREA(HECTARES)
OUT OF DAM INUNDATE	442.



COMPOSITE HAZARD MAPS AND SITE SCREENING

MAP FILE APPLICATION

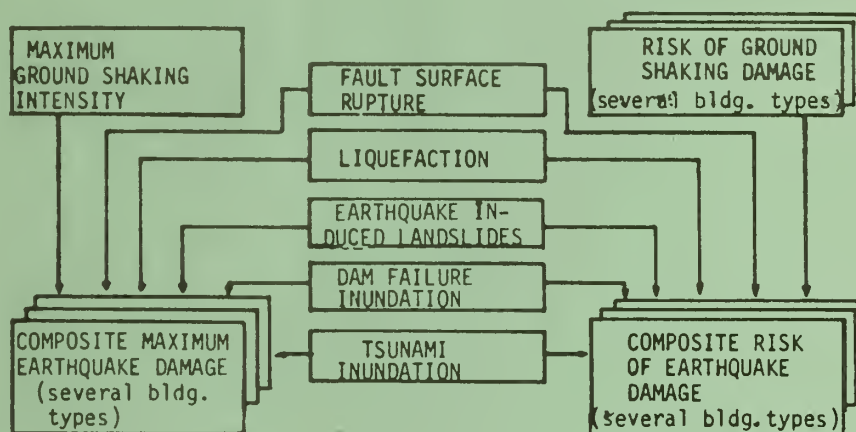
COVERAGE: All nine Bay Area counties with San Mateo County, Petaluma, and the East Bay ridgelands in more detail

SOURCE FILES: Maximum Ground Shaking Intensity; Risk of Ground Shaking Damage; Fault Surface Rupture; Liquefaction Susceptibility and Potential; Earthquake-Induced Landslide Susceptibility (and Potential when available); Tsunami Hazard Areas; and Dam Failure Hazard Areas



March 1981
Hectare resolution

DESCRIPTION OF PRODUCT:



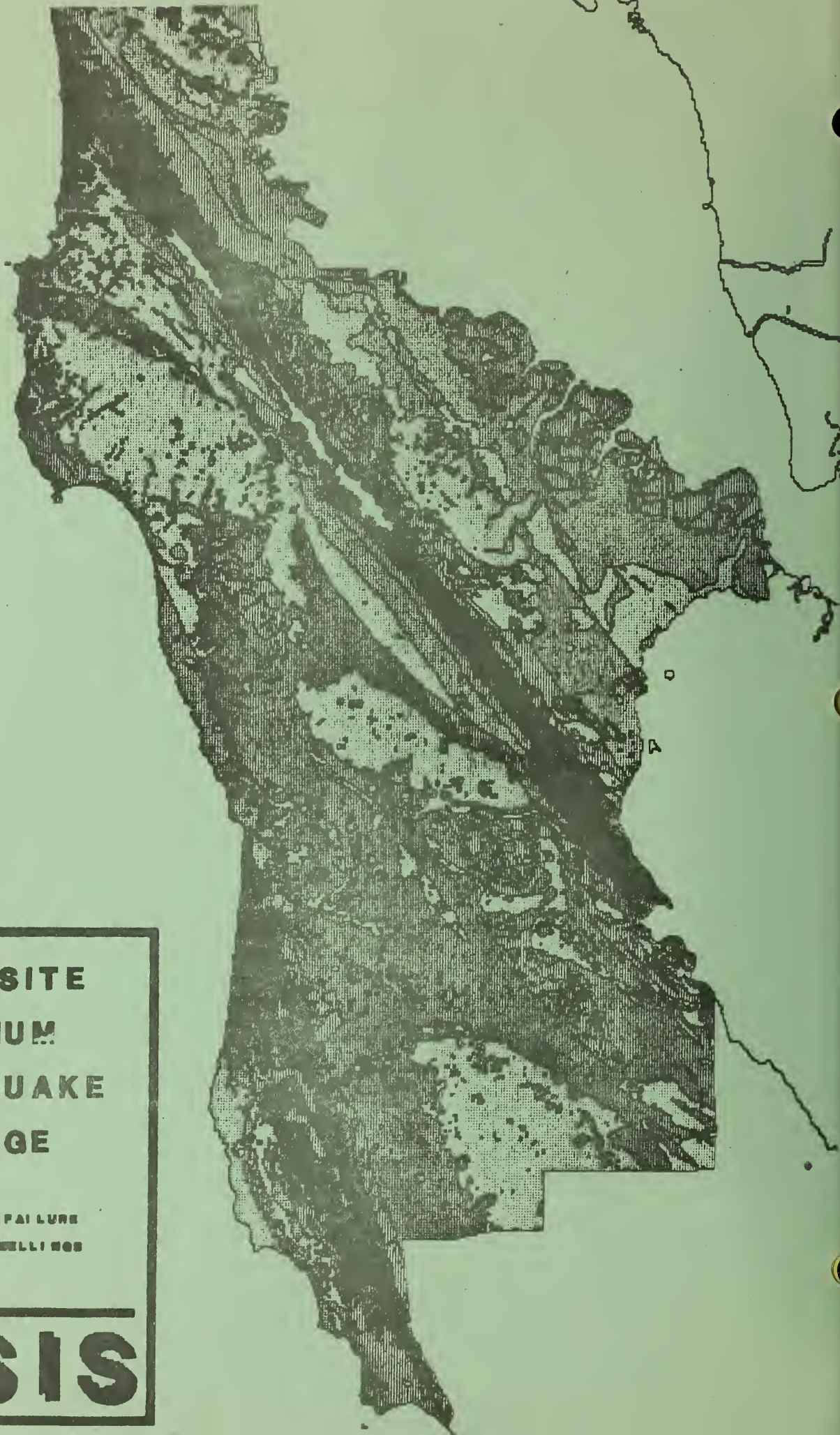
An example of a composite map appears on the reverse of this sheet. Uses for these maps are described in Working Paper #14.

FURTHER INFORMATION ON THIS FILE IS CONTAINED IN:

- o Working Paper #9: Earthquake Map Applications for Composite Earthquake Hazard Mapping
- o Working Paper #11: The Method Developed to Extend Detailed Map Information Beyond San Mateo County to Selected Areas of Significant Development Pressure
- o Working Paper #14: Using Earthquake Hazard Maps for Site Screening and Anticipating Mitigation Benefits and Costs

LIMITATIONS AND FUTURE PLANS:

Any composite maps that are produced at this time have two limitations. First, the landslide susceptibility file is only available for part of the region. Second, the lack of information on landslide opportunity in earthquakes makes the production of a landslide potential map impractical. The current data on damage associated with both landslides and liquefaction make composite maps only a rough estimate of areas that are relatively safe.



**COMPOSITE
MAXIMUM
EARTHQUAKE
DAMAGE**

WITHOUT DAM FAILURE
WOOD FRAME DWELLINGS

BASIS

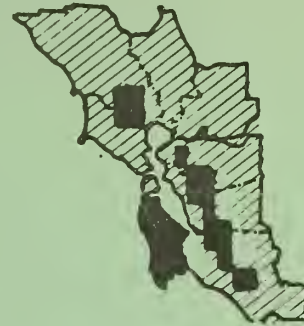


ASSESSMENT OF CURRENT AND PROJECTED PROPERTY AND POPULATION AT RISK

MAP FILE APPLICATION

COVERAGE: All nine Bay Area counties with San Mateo County more detail

SOURCE FILES: This application can use any of the basic data map files or hazard map files together with the land use jurisdiction and census tract files.



March 1981
Hectare resolution

DESCRIPTION OF PRODUCT:

This application can produce tables of the amount of land in each hazard category on each hazard map file by:

- o Census tract
- o City sphere of influence
- o County
- o Land use

An example of one of these types of tables is reproduced on the back of this sheet. Census tract data has been disaggregated by using the land use data to produce statistics on population at risk. Comparisons of existing and projected risk in San Mateo County have been made and indicate that areas of high potential for development are less hazardous than existing developed areas.

FURTHER INFORMATION ON THIS FILE IS CONTAINED IN:

- o Working Paper #10: Earthquake Map Applications for Automated Assessment of Property and Population at Risk
- o Working Paper #15: Assessment of Current and Projected Property and Population at Risk - An Update

LIMITATIONS AND FUTURE PLANS:

At the present time, the land use file is available only for San Mateo County so some of the more sophisticated applications only can be performed for that area. In addition, the extent of coverage of the data files may limit those areas where tables can be produced.

AREA (IN HECTARES) FOR CATEGORIES OF
MAXIMUM GROUND SHAKING INTENSITY
BY JURISDICTION

SAN FRANCISCO INTENSITY SCALE

JURISDICTION

	<u>4E</u>	<u>E</u>	<u>D</u>	<u>C</u>	<u>B</u>	<u>A</u>
<u>Cities</u>						
ATHERTON	0.	0.	573.	711.	10.	0.
BELMONT	0.	129.	785.	283.	21.	9.
BRISBANE	0.	130.	7.	427.	0.	0.
BURLINGAME	0.	0.	123.	342.	638.	114.
COLMA	0.	0.	6.	389.	86.	0.
DALY CITY	0.	161.	54.	677.	746.	572.
FOSTER CITY	0.	0.	0.	921.	72.	6.
HALF MOON BAY	871.	802.	1531.	2022.	548.	0.
HILLSBOROUGH	0.	0.	866.	675.	122.	19.
MENLO PARK	0.	4.	806.	1494.	698.	0.
MILLBRAE	0.	0.	0.	58.	579.	208.
PACIFICA	0.	686.	1078.	804.	525.	331.
PORTOLA VALLEY	0.	4.	244.	1120.	831.	1108.
REDWOOD CITY	0.	16.	1077.	3137.	1606.	43.
SAN BRUNO	0.	0.	8.	267.	543.	708.
SAN CARLOS	0.	95.	1061.	581.	20.	3.
SAN MATEO	0.	21.	1060.	2203.	263.	10.
SOUTH SAN FRANCISCO	0.	122.	157.	1155.	752.	307.
WOODSIDE	0.	0.	1060.	2107.	1058.	1249.

Counties

ALAMEDA	39296.	50523.	42469.	25213.	33543.	0.
CONTRA COSTA	54370.	69843.	33027.	13644.	16528.	0.
MARIN	8125.	57824.	40531.	14608.	9295.	4383.
NAPA	141612.	33736.	10281.	9430.	388.	0.
SAN FRANCISCO	21.	1216.	1090.	7643.	2091.	0.
SAN MATEO	1308.	21422.	36739.	32231.	18267.	6356.
SANTA CLARA	100607.	44197.	87339.	60875.	37206.	4340.
SOLANO	72112.	93703.	16815.	21528.	11245.	0.
SONOMA	94519.	147883.	88234.	38634.	35104.	6005.

Regional

Total

BAY AREA	511970.	520347.	356525.	223806.	163667.	21084.
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WORKING PAPERS
(revised March 1981)

The working papers referenced in this guide are not automatically included in this document. They can be ordered from ABAG's offices at a small charge. This user's guide, complete with all Working Papers, has automatically been forwarded to the planning director in each city and county in the Bay Area.

The available working papers include:

- #1 - Faults and Ground Shaking Intensity -- a description of those faults from which significant ground shaking could originate, including source of mapping, length, character of motion, maximum magnitude, maximum intensity, relative slip rate and recurrence intervals for various earthquakes
- #2 - Attenuation, Geologic Materials and Ground Shaking -- a description of an attenuation relationship between intensity and distance from faults for a standard geologic material, a method of combining geologic materials into groups with similar responses to earthquake ground shaking, and intensity increments to be added to the standard intensity for each of the seismically distinct groups of geologic materials
- #3 - Damage and Ground Shaking Intensity -- a description of how experience from past earthquakes can be used to estimate the damage different types of buildings would experience when subjected to various intensities of ground shaking; also a description of how damage data, the intensity maps, and recurrence interval information can be used to produce maps of risk of ground shaking damage for various building types
- #4 - Liquefaction Potential Mapping -- a description of the likelihood of finding cohesionless sediments within a geologic map unit, the likelihood that those sediments (when saturated) would be susceptible to liquefaction, the likelihood of finding those sediments saturated, and liquefaction opportunity (based on recurrence intervals of earthquakes and the distance from various faults at which liquefaction can occur)
- #5 - Slope Stability Mapping -- a description of how slope, geology and existing landslides can be used to estimate landslide susceptibility in an earthquake and under more normal circumstances
- #6 - Tsunami Inundation Areas -- a description of the data used to develop a tsunami hazard map and of the relative risk associated with tsunamis
- #7 - Dam Inundation Areas -- a description of dam inundation mapping and of the relative risk associated with dam failure

- #8 - Earthquake Map Applications for Automated Environmental Impact Assessment -- a description of how hazard map files can be used to produce a background document for development proposals that can be incorporated into an Environmental Impact Report
- #9 - Earthquake Map Applications for Composite Earthquake Hazard Mapping -- a description of how the various hazard maps can be combined to yield two types of hazard maps of total earthquake-associated damage
- #10 - Earthquake Map Applications for Automated Assessment of Property and Population at Risk -- a description of how tables of area in cities, counties, census tracts and land use can be created for each hazard map category, as well as some sample tables with a discussion of the conclusions that can be formed. In addition, the feasibility of disaggregating census tract data on population using land use to create data on population at risk in various hazard categories is discussed.
- #11 - The Method Developed to Extend Detailed Map Information Beyond San Mateo County to Selected Areas of Significant Development Pressure -- a description of the process used to select the areas of development pressure, the refinements and extensions of the geology, landslide, and topography files, and the extensions of the intensity maps, landslides susceptibility maps, and composite maps
- #12 - Ordering and Using Earthquake Hazard Maps in Local General Plans -- a description of the types of maps available, their relationship to maps recommended for inclusion in local plans by the State Office of Planning and Research General Plan Guidelines, and the scale and form in which those maps are available
- #13 - Automated Environmental Impact Assessment - An Update -- a description of the revised setting and impacts section and an extensive description of possible mitigation measures
- #14 - Using Earthquake Hazard Maps for Site Screening and Anticipating Mitigation Benefits and Costs -- a description of the use of these maps for pointing to areas that should be easier to develop in a safe manner, as well as for warning of the costs associated both with potential damage and with necessary hazard mitigation
- #15 - Assessment of Current and Projected Property and Population at Risk - An Update -- a description of tabulations of population at risk, rather than land area, the issues surrounding the development of a risk map based on existing building types, comparisons of various methods of estimating earthquake losses, and comparisons of existing and projected risk. San Mateo County is used as a study area.

